NATIONAL PETROLEUM COUNCIL

CHARTING THE COURSE

Reducing GHG Emissions from the U.S. Natural Gas Supply Chain

Washington, D.C.
April 23, 2024

Agenda

1. Member feedback on draft report
2. Study process, findings, and recommendations
3. How to access the study report
4. Recommendations for target audiences
   - Industry and related associations
   - Department of Energy
   - Federal, state, Tribal, and local governments

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Member feedback on draft report

- Addressed the importance of natural gas as part of the electric grid reliability
- Added reference to North American Electricity Reliability Corporation findings on natural gas and grid reliability, with recommendation for government/industry engagement
- Added additional details on recent and ongoing technology deployment for methane slip reduction in gas-powered engines
- In response to Member request on renewable natural gas, explained that this was out of scope for this study
- Regulatory fixes to repurpose wells for non-O&G purposes
- Community engagement should include all relevant community members

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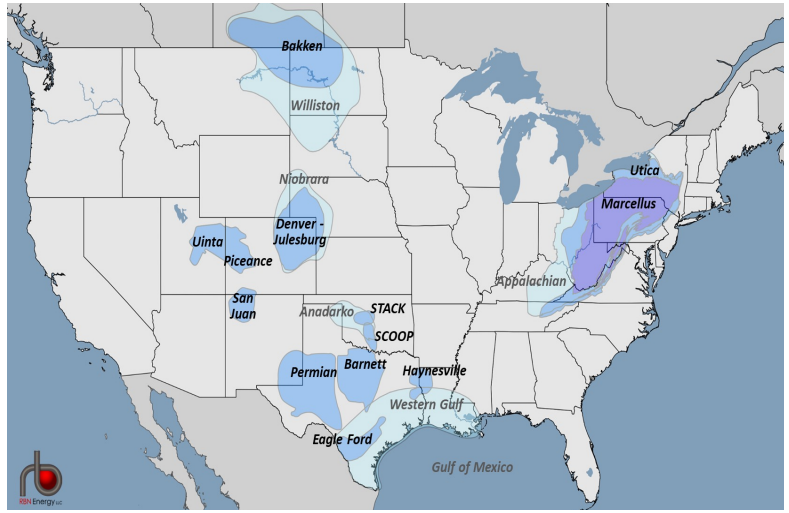
Reducing GHG Emissions from the U.S. Natural Gas Supply Chain

Study process, findings, and recommendations

The Challenge: Natural gas supply chain greenhouse gas reduction

A valuable resource…

U.S. MAJOR NATURAL GAS BASINS



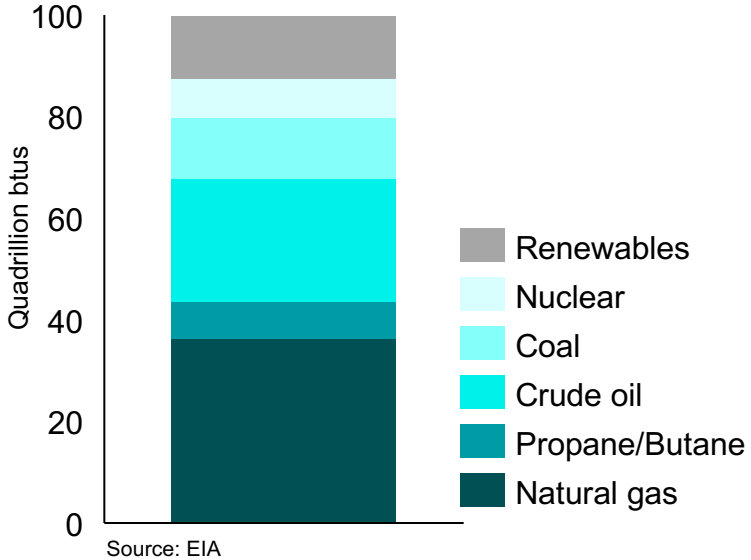
Source: RBN

The U.S. has one of the world's largest natural gas resource bases

The U.S. is the leading producer of natural gas. Resources of 3,978 TCF will last over 100 years at current rates.

that the U.S. depends on…

PRIMARY ENERGY PRODUCTION



Source: EIA

It is the largest primary energy source

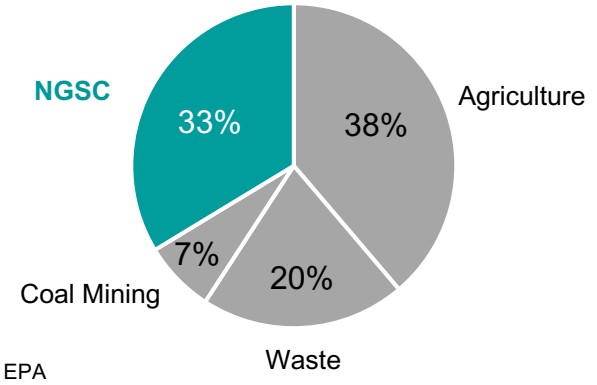
Natural gas and its liquids supplied 43% of U.S. primary energy production in 2022. Natural gas is also the top source of electricity generation.

but it faces challenges

% OF U.S. GREENHOUSE GAS (GHG) EMISSIONS FROM NATURAL GAS SUPPLY CHAIN (NGSC)[1]

5%	33%	8%
Carbon dioxide (CO_2)	Methane (CH_4)	GHG emissions[2]

Methane Emissions



Source: EPA

Producing and delivering natural gas generates GHG emissions

[1]Direct emissions from production, gathering, processing, transmission, liquefaction, and shipping to end-user

[2]Net CO_2 Equivalent on a GWP100 basis

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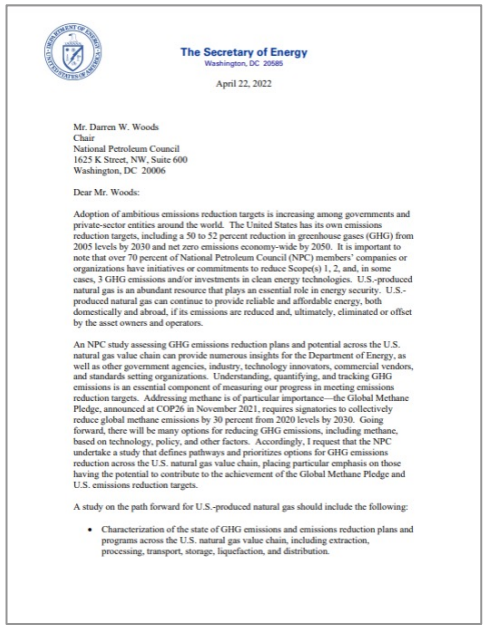
The Response: A collaborative study

A clear mission…



The Secretary of Energy
Washington, DC 20585

April 22, 2022

Mr. Darren W. Woods
Chair
National Petroleum Council
1625 K Street, NW, Suite 600
Washington, DC 20006

Dear Mr. Woods:

Adoption of ambitious emissions reduction targets is increasing among governments and private-sector entities around the world. The United States has its own emissions reduction targets, including a 50 to 52 percent reduction in greenhouse gases (GHG) from 2005 levels by 2030 and net zero emissions economy-wide by 2050. It is important to note that over 70 percent of National Petroleum Council (NPC) members' companies or organizations have initiatives or commitments to reduce Scope(s) 1, 2, and, in some cases, 3 GHG emissions and/or investments in clean energy technologies. U.S.-produced natural gas is an abundant resource that plays an essential role in energy security. U.S.-produced natural gas can continue to provide reliable and affordable energy, both domestically and abroad, if its emissions are reduced and, ultimately, eliminated or offset by the asset owners and operators.

An NPC study assessing GHG emissions reduction plans and potential across the U.S. natural gas value chain can provide numerous insights for the Department of Energy, as well as other government agencies, industry, technology innovators, commercial vendors, and standards setting organizations. Understanding, quantifying, and tracking GHG emissions is an essential component of measuring our progress in meeting emissions reduction targets. Addressing methane is of particular importance—the Global Methane Pledge, announced at COP26 in November 2021, requires signatories to collectively reduce global methane emissions by 30 percent from 2020 levels by 2030. Going forward, there will be many options for reducing GHG emissions, including methane, based on technology, policy, and other factors. Accordingly, I request that the NPC undertake a study that defines pathways and prioritizes options for GHG emissions reduction across the U.S. natural gas value chain, placing particular emphasis on those having the potential to contribute to the achievement of the Global Methane Pledge and U.S. emissions reduction targets.

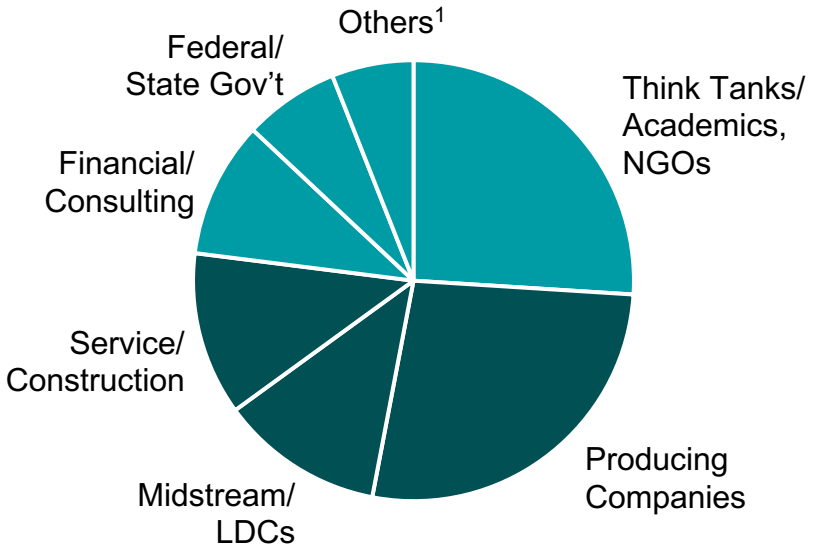
A study on the path forward for U.S.-produced natural gas should include the following:

- Characterization of the state of GHG emissions and emissions reduction plans and programs across the U.S. natural gas value chain, including extraction, processing, transport, storage, liquefaction, and distribution.

DOE Sec. Granholm requested NPC Study

Address potential options to reduce GHGs in the U.S. natural gas supply chain.

with over 200 contributors…



NPC mobilized a diverse team

NGSC GHG emissions reduction opportunities evaluated by representatives from governments, tribes, NGOs and industry.

[1]Others: Tribes, Electrics, Large Consumers, International

and a focused effort

Over **2** years

38 recommendations in executive summary

5 task groups

Baseline and Expected Pathways
Societal Considerations and Impacts (SCI)
Detection and Quantification
Life Cycle Assessment
Analytics and Tradeoffs

Emphasized societal considerations and impacts

Collaborated with NPC Hydrogen study on SCI and community engagement.

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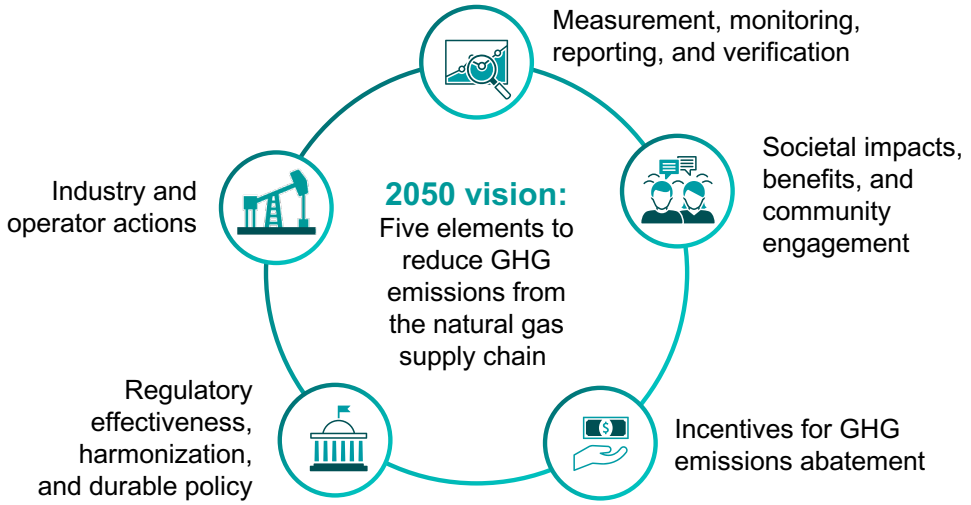
The Integrated Solution: *Charting the Course*

A collaborative vision…



and a crucial role for natural gas

Abundant, affordable natural gas is the largest source of primary energy production and will continue to play a crucial role in energy security and an important role in economic security beyond 2050 under all Energy Information Agency (EIA) scenarios.[2]

With advances in technology and policy, one study[1] pathway outlines a 2050 reduction potential of:

70% methane ↓

33% carbon dioxide ↓

52% combined GHGs ↓

[1]Technology, Innovation, and Policies (TIP) pathway, relative to a 2020 baseline
[2]EIA does not currently provide a scenario that targets net zero by 2050. EIA scenarios all assume existing policies and regulations only.

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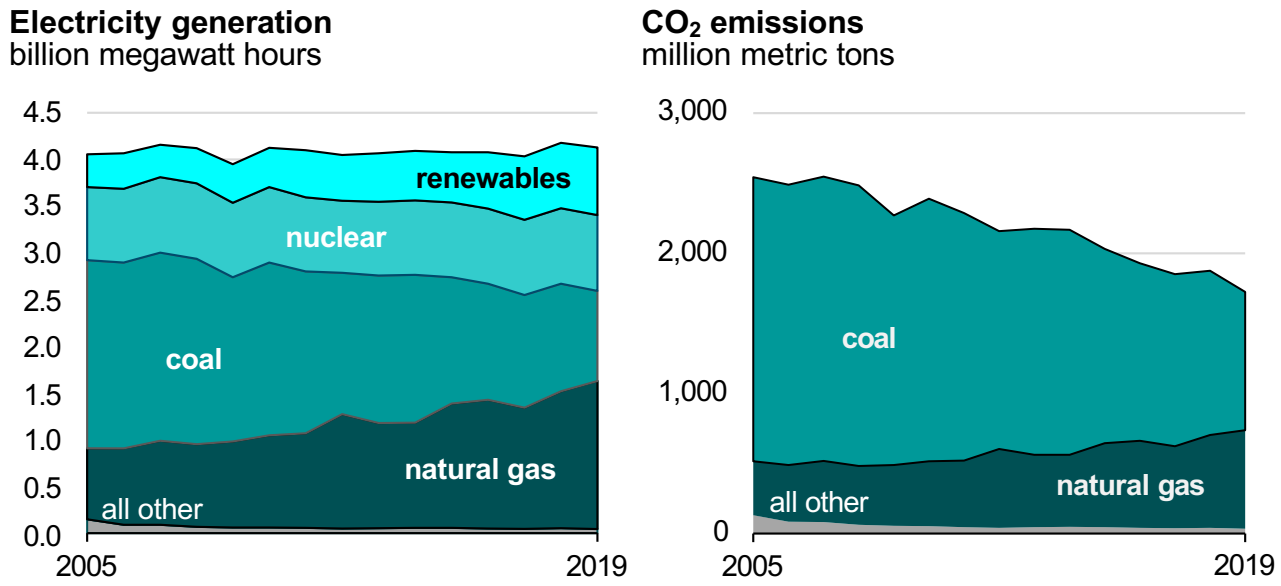
Natural gas plays a crucial role in U.S. GHG emissions reduction

U.S. electric power sector electricity generation and CO_2 emissions by source (2005-2019)



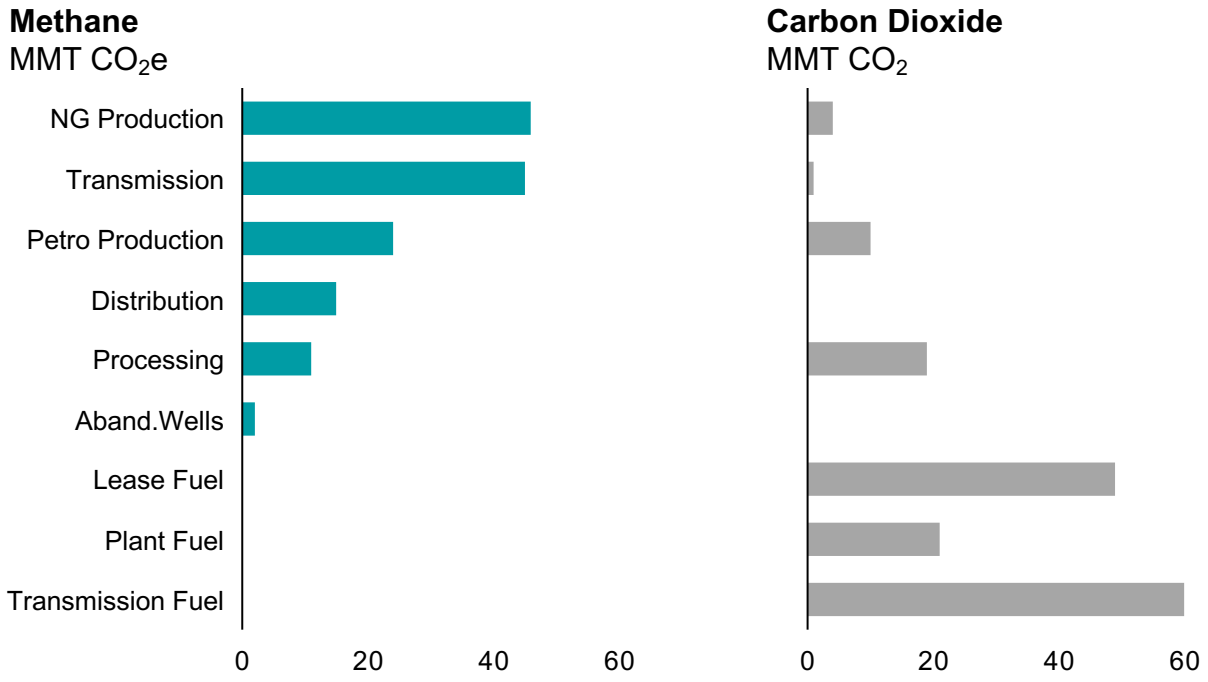
Source: U.S. Energy Information Administration, *Power Plant Operations Report*

On natural gas displacing coal, EIA analysis stated...

"*Of the 819 million metric ton decline in CO_2 emissions from 2005 to 2019… almost 532 million metric tons (65%) of the decline in CO_2 emissions is attributable to the shift from coal-fired to natural gas-fired electricity generation.*"

Methane and carbon dioxide have different sources

Emissions along the natural gas supply chain[1]



Source: Data from EPA with energy allocation

- Natural gas and petroleum production account for the most methane emissions
- Fuel use for transmission accounts for the most CO_2 emissions

The study recommends reducing GHG emissions at the source-level, which is relevant for a wide range of future energy scenarios.

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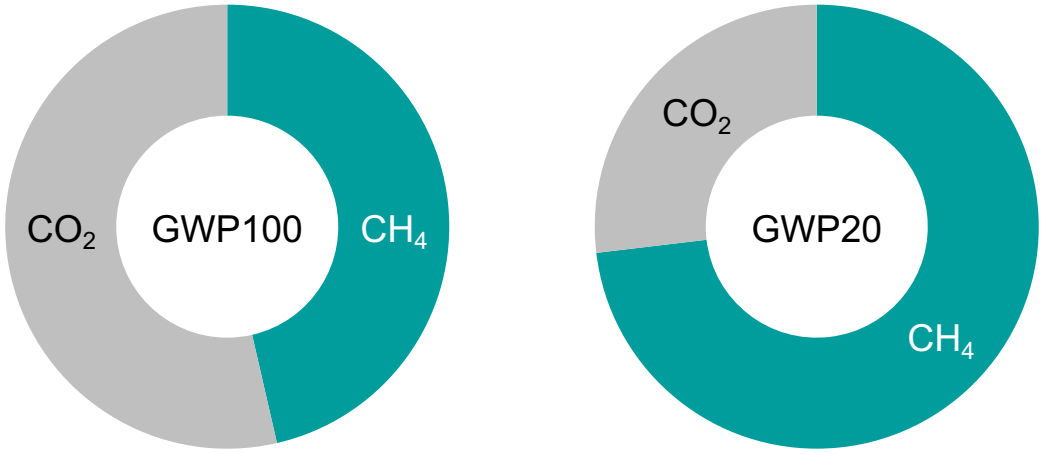
[1]Estimates for this figure allocate emissions on an energy basis for all products (oil, natural gas, and NGPLs) as recommended for LCAs in Chapter 4

Methane emissions matter and are on the decline

2021 NGSC GHG emissions, two GWP[1] views



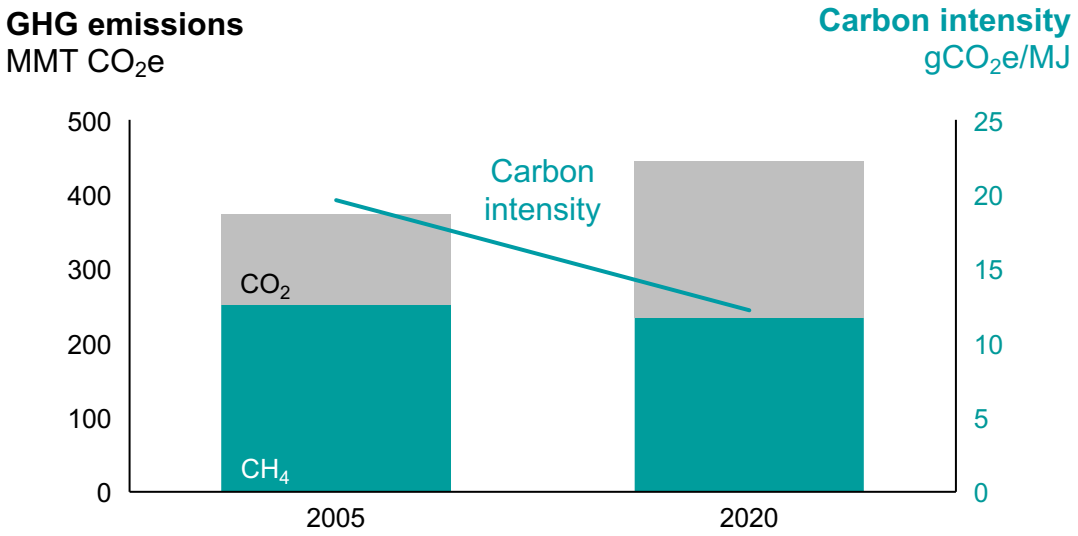
Source: Data from EPA with energy allocation

Emissions are roughly even on a GWP100 basis, but methane dominates on a GWP20 basis

GWP seeks to place GHG emissions on a carbon dioxide equivalent (CO_2e) basis.

[1]GWP Global Warming Potential AR5 100-yr and 20-yr basis

NGSC GHG Emissions and Carbon Intensity



Source: Data from EPA with energy allocation

NGSC Methane and Carbon intensity declined

Reduced methane emissions and carbon intensity, but CO_2 and total emissions increased as gas production roughly doubled from 2005 to 2020.

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Methane regulations, voluntary efforts and technologies are advancing rapidly

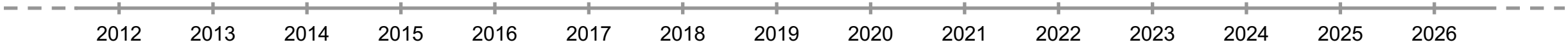
Regulations and Policies

- OOOO Regulations (EPA)
- Start of GHG Reporting (Subpart W)
- First state methane regulations (CO)

- OOOOa Regulations (EPA)

- Global Methane Pledge
- Methane rules (OOOOb/c)
- Most recent EPA Subpart W changes proposed
- MMRV program (DOE)

- Super-Emitter Program
- Subpart W reporting methods tied to IRA waste emissions charge with $1.5B funding
- Some states developing OOOOc plans for existing sources



Research, technology, and voluntary advances

- First methane measurement studies in U.S. from unconventional oil and gas production

- ARPA-E MONITOR program catalyzes new methane detection technology development
- First METEC site

- Expansion of DOE research funding for methane measurement, monitoring, and mitigation
- Oil and Gas Methane Partnership 2.0
- International Methane Emissions Observatory

- New Global Satellites Operational
- Regulatory approval of alternative technology expected for use by operators

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Collaborative opportunities for all stakeholders

***Charting the Course*:**
Three pathways to reduce NGSC GHG emissions

Existing Policies (EP)

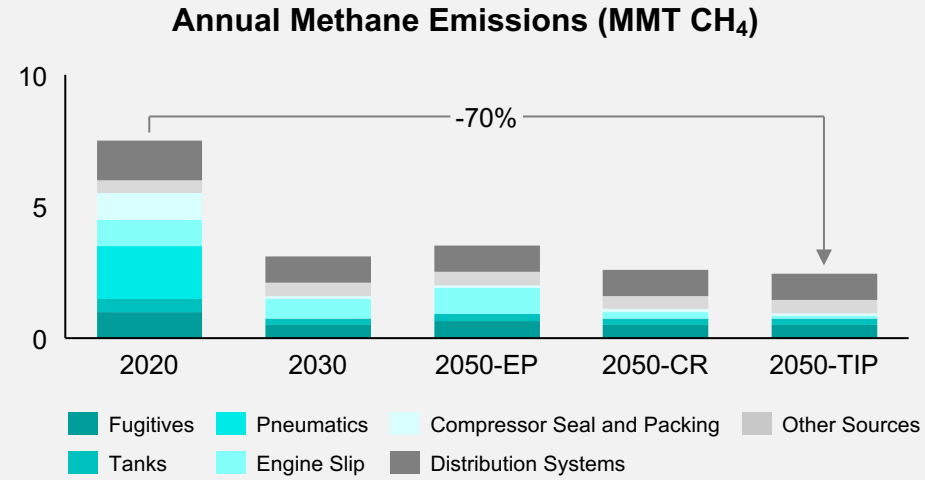
- Includes IRA, OOOOb,c, existing state regs, and existing voluntary actions
- Excludes additional technology, breakthrough, or market mechanism deployment

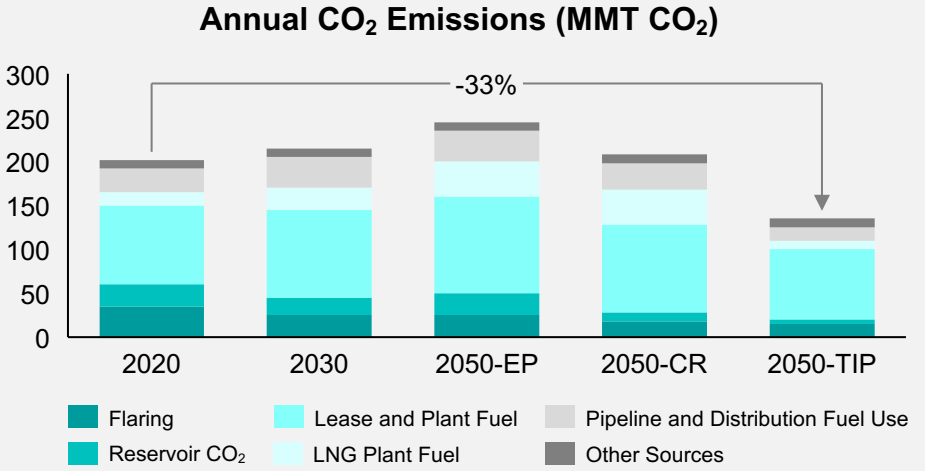
Continued Reductions (CR)

- On trend improvements for voluntary efforts and technology progress
- Does not assume additional market mechanisms

Technology, Innovation, and Policy (TIP)

- Policy and voluntary efforts shift to CO_2 emissions reduction
- Assume advancements in technology
- Market mechanisms support wider carbon capture and storage (CCS) deployment and electrification





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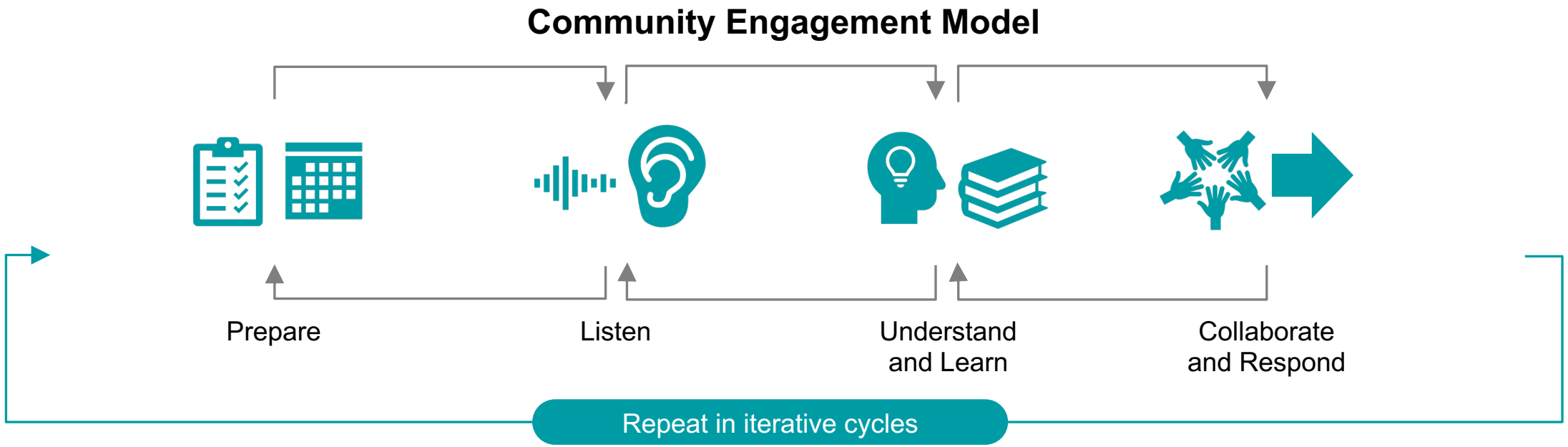
SCI: It's not just what you do, it's how you do it



***Charting the Course* conducted six focus groups and a poll to better understand perspectives of impacted communities**

The study also partnered with the NPC hydrogen study to examine SCI and community engagement best practices, including:

- Authenticity and building trust
- Transparency
- Early, open, responsive, and accessible engagement
- Identifying and responding to community input and concerns
- Articulation and delivery of community value and recognition of value

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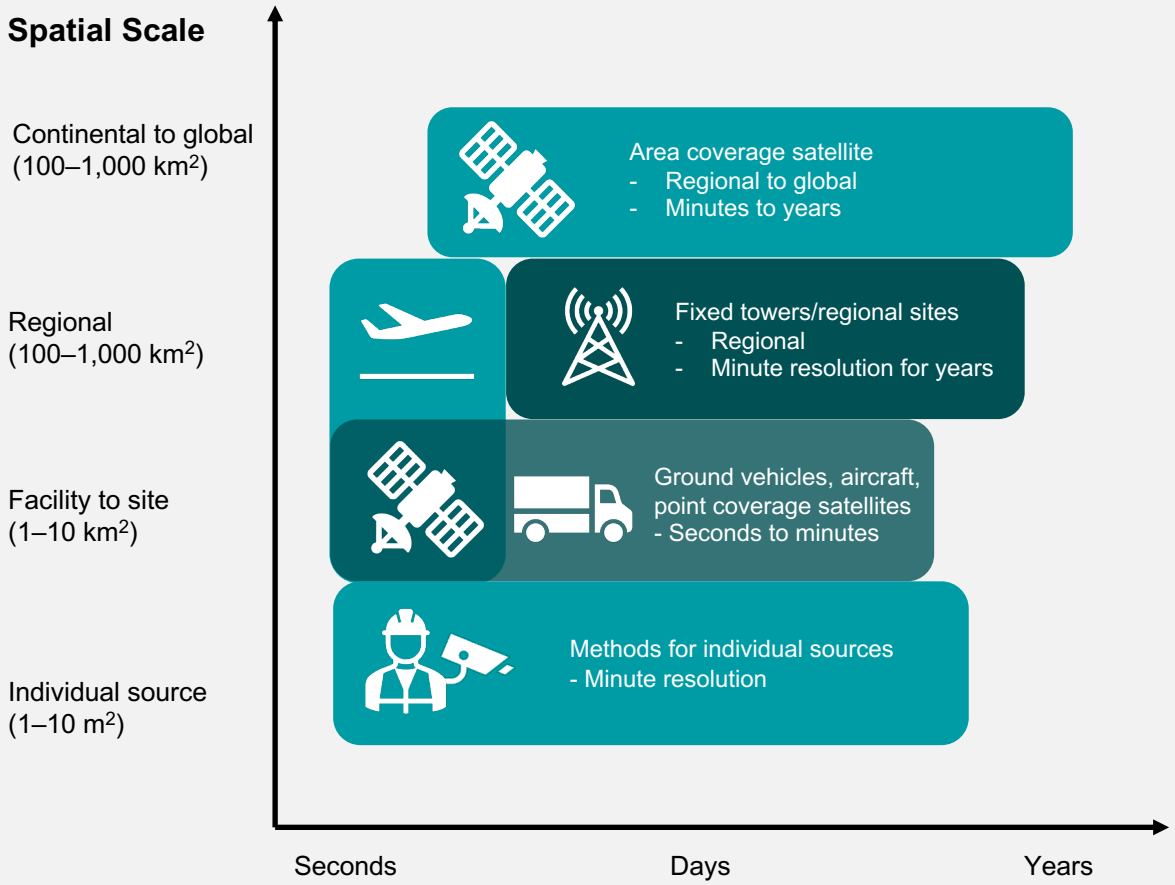
Detection technology varies spatially and over time



Detection technologies have advanced rapidly. However:

- They vary in spatial and temporal scale but quantification remains a challenge
- and Less Capitalized Operators expressed concern that supply chain issues could prevent cost-effective and timely solutions

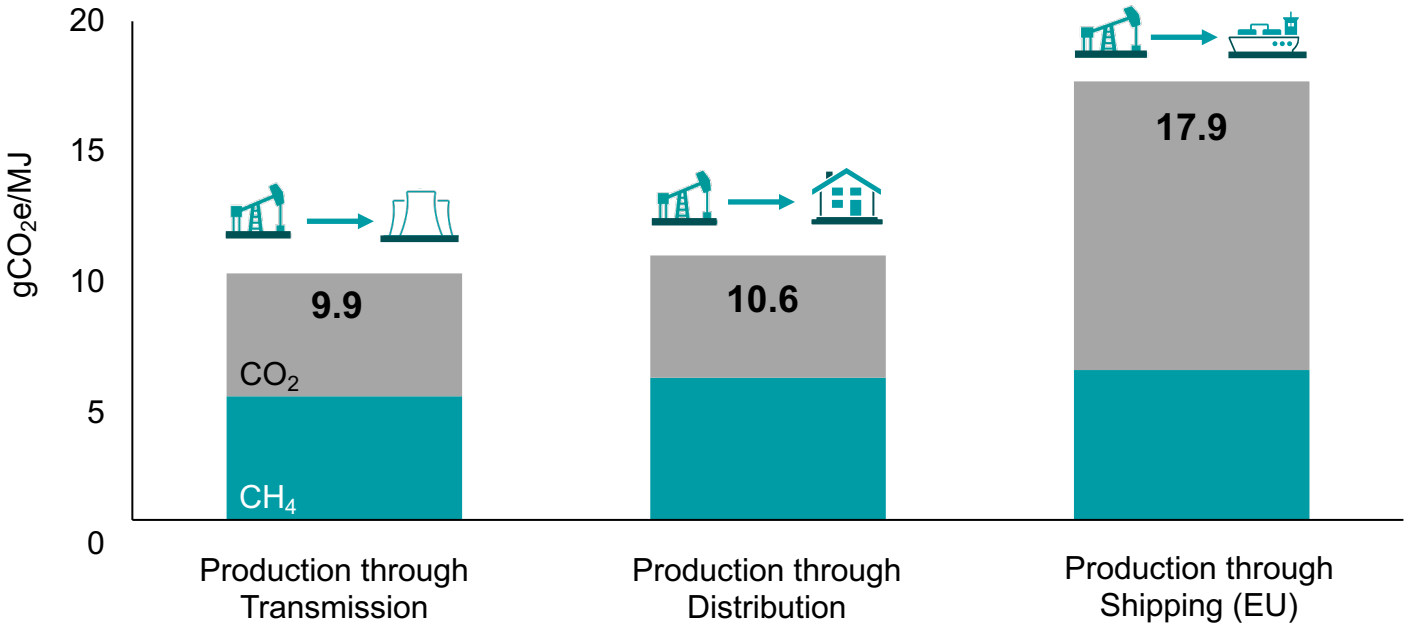
Example Recommendation

The NPC recommends:

- *…scaling up production and deployment of equipment and technology to abate methane emissions.*
- *…directly funding and tax credits to support innovation and deployment of equipment and technology.*

LCAs are critical tools to identify and quantify GHG emissions

Life cycle GHG emissions intensity delivered[1]



Life cycle assessments (LCAs) can be complex and time consuming

The NPC developed a streamlined LCA model that is publicly available – SLiNG-GHG[2].

Example LCA Recommendation

- *The NPC recommends that DOE support the adoption of open-source, user-defined, simplified and streamlined models such as SLiNG-GHG*
- *as part of its Measuring, Monitoring, Reporting, and Verifying (MMRV) efforts*
- *and through the Federal Life Cycle Assessment Commons interagency process*

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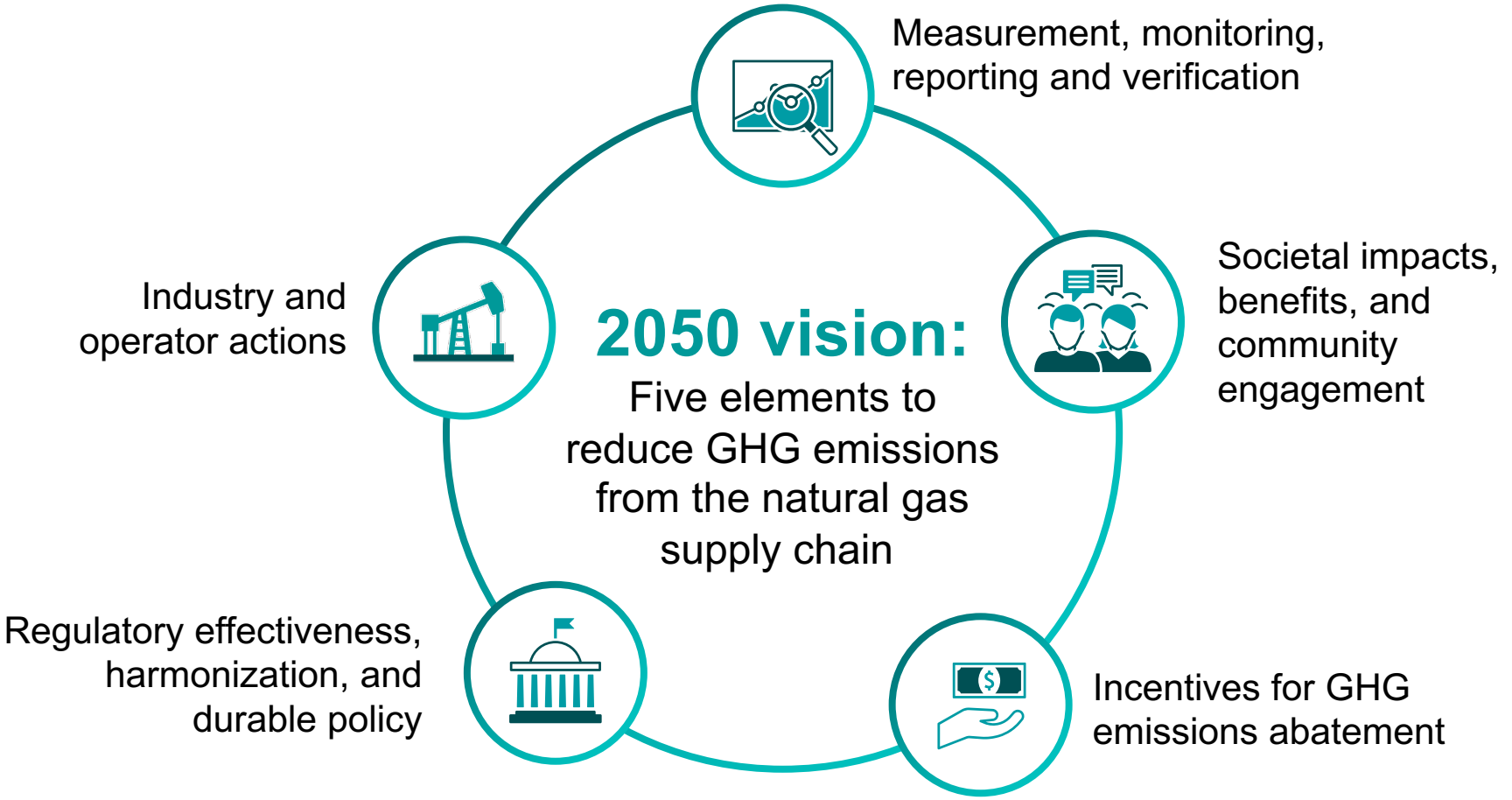
[1] Delivered MJ NG accounts for all NG used along the NGSC (GWP100)
[2] Streamlined Life Cycle Assessment for Natural Gas GHG

Industry, government, communities and academia working together to support GHG emissions reductions



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2050 vision elements and categories

	Taking action	Scaling impact	Building foundations
 Measurement, monitoring, reporting, and verification	Enhance capacity to monitor and report methane emissions Improve use of and confidence in GHG emissions reporting	Scale the use of emissions monitoring and reporting Harmonize GHG emissions data and tools	Deploy standards to differentiate GHG intensity of natural gas
 Societal impacts, benefits, and community engagement	Maximize effectiveness of community benefits; improve understanding of impacts	Build capacity for community engagement best practices; document impacts and benefits	Scale government incentives for and expand use of community benefit planning
 Incentives for GHG emissions abatement	Expand existing market mechanisms and voluntary initiatives	Introduce new market mechanisms, voluntary standards and tech. investment	Develop new economy-wide and/or sectoral market mechanisms
 Regulatory effectiveness and durable policy	Maximize effectiveness and impact of existing and proposed regulations	Demonstrate, deploy, and harmonize technologies to support regulations	Implement durable policy to create a stable investment environment
 Industry and operator actions	Develop additional capabilities of oil and gas operators	Enhance industry and operator cooperation	Develop and deploy new methods for assessing industry progress

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Recommendation themes

- **Energy and economic security**
  Leveraging consequential analysis and recognizing the low GHG intensity of US-produced natural gas and LNG through climate and energy diplomatic efforts. Harmonizing methane policy across federal and state governments through the White House Methane Task Force adopting policy that utilizes durable market mechanisms to drive economically efficient GHG emissions reductions.

- **Promote SCI awareness**
  Committing investments to address social, environmental, and public health impacts and benefits of NGSC projects and activities and pursuing research based on Societal Considerations and Impacts best practices and community engagement.

- **Incorporate more measurement**
  Incorporating advanced technology measurements into measurement, monitoring, reporting, and verification (MMRV) programs and leveraging this study for development of a common MMRV global framework.

- **Technology advancements to further emission reductions**
  Prioritizing research, development, demonstration, and deployment (RDD&D) of technologies for reducing and monitoring the GHG intensity of the NGSC.

- **Leverage life cycle assessments**
  Leveraging LCAs to quantify supply chain carbon intensities and develop measurement-informed geospatial LCA tools.

- **Employ enablers for change**
  Revitalizing an organization like the Petroleum Technology Transfer Council for efficiently socializing best practices and technology adoption throughout industry.

How to access the study report

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Reducing GHG Emissions from the U.S. Natural Gas Supply Chain

Study website:

chartingthecourse.npc.org

Charting the Course: Reducing GHG Emissions from the U.S. Natural Gas Supply Chain

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Appendix

Recommendations for target audiences

Recommendations[1] for industry and related associations

Reducing emissions from the U.S. NGSC is a priority that requires collaborative solutions. By implementing these recommendations, Government can help accelerate GHG emissions reductions in natural gas production, transportation, distribution, and LNG exports.

Measurement, monitoring, reporting and verification

- Leverage LCAs to conduct contribution analyses.
- Utilize a harmonization process in the evaluation of LCA results.
- Participate in federal agency led stakeholder working groups on MMRV.

Regulatory effectiveness and durable policy

- Engage with federal and state governments to design durable policies.
- Fund policy and regulatory education and share best practices with smaller operators through trade associations.

Incentives for GHG emissions abatement

- Develop recognized frameworks, standards, and metrics for differentiated gas.[2]

Societal impacts, benefits, and community engagement

- Deploy effective community engagement practices during siting and development of infrastructure.
- Avoid or mitigate adverse impacts on communities and maximize community benefits during GHG emissions reduction projects.
- Develop and share community engagement training programs through trade associations.

Industry and operator actions

- Dedicate additional resources to analyzing emissions reduction opportunities.
- Revitalize an organization in the model of the Petroleum Technology Transfer Council (PTTC) to share emissions reduction technology and best practices.

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[1]Not indicative of all recommendations, accompanying language, and findings that are provided in study, only provides high-level recommendations for industry and trade associations.
[2]This recommendation is directed towards standards-setting bodies, not specifically industry or a trade association.

Recommendations[1] for Department of Energy

Reducing emissions from the U.S. NGSC is a priority that requires collaborative solutions. By implementing these recommendations, Government can help accelerate GHG emissions reductions in natural gas production, transportation, distribution, and LNG exports.

Measurement, monitoring, reporting and verification

- Support detection technology improvement and evaluation through the creation of technology evaluation centers.
- Coordinate with EPA to incorporate advanced technology measurements into Subpart W.
- Support the development of public-private partnership to improve methane measurement technology and promote consistent interchange formats for emissions data.
- Integrate measurement data into LCAs through the creation of an advisory group.
- Publish best practice guidelines for conducting natural gas LCAs.

Regulatory effectiveness and durable policy

- Work with EPA to incorporate evolving technology into regulations.
- Support the democratization of LCAs as a screening tool for stakeholders who do not have the capacity to conduct detailed life cycle assessment modeling.

Incentives for GHG emissions abatement

- Undertake RDD&D to reduce the carbon intensity of energy use in the natural gas supply chain for compression, heat, and power activities.
- Fund the improvement of site/facility-scale data systems used in the public attribution of emissions sources through emissions detection and quantification solutions.

Societal impacts, benefits, and community engagement

- Undertake an additional societal considerations and impacts study.
- Commit to investing in efforts that consider the societal impacts of natural gas projects.
- Fund research of effective industry-community engagement best practices.
- Commission additional workforce study on skills needed for GHG emissions reduction projects.

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[1]Not indicative of all recommendations, accompanying language, and findings that are provided in study, only provides high-level recommendations for DOE.

Recommendations[1] for federal, state, Tribal, and local governments

Reducing emissions from the U.S. NGSC is a priority that requires collaborative solutions. By implementing these recommendations, Government can help accelerate GHG emissions reductions in natural gas production, transportation, distribution, and LNG exports.

Measurement, monitoring, reporting and verification

- Work with the White House Methane Task Force to harmonize reporting, control, and technology requirements.

Regulatory effectiveness and durable policy

- Engage with industry to design durable policies.
- Advance permitting reform at every level of government.
- Coordinate policies and initiatives for low-carbon technology RDD&D.
- Support diplomatic efforts to standardize exported products' GHG intensity.

Incentives for GHG emissions abatement

- Adopt market mechanism options to generate incentives for investments in GHG emissions reduction.
- Review options for emissions reduction incentives for marginal wells, including the deduction of GHG emissions reduction investments from state/federal taxes or royalty obligations.

Societal impacts, benefits, and community engagement

- Charter public/private councils of excellence in effective industry-community engagement practices.
- Assess which communities might benefit from or be harmed by GHG emissions reduction infrastructure siting or operational decisions, policies, and technologies.

[1]Not indicative of all recommendations, accompanying language, and findings that are provided in study, only provides high-level recommendations for government entities.

Study governance and operating model

NPC Study Committee

Ryan Lance, ConocoPhillips – Chair
Hon. David Turk – Government Representative
NPC members (~60)

Steering Committee

Ryan Lance, ConocoPhillips – Chair
Subset of delegates of the Study Committee
(~15 members)

Coordinating Subcommittee (CSC)

John Dabbar, ConocoPhillips – Chair
Ryan Peay – Government Representative
Christopher Freitas – Asst. Government Representative
~35 members, from a mix of industry, NGOs, academia, and government

Study Staff

Janice Menke, ConocoPhillips – Project Manager
Baseline/Pathways and Detection & Quantification Liaison
Paul McNutt, ConocoPhillips – Consultant
LCA and Analytics Liaison, Prior and Concurrent Studies Coordinator, Education and Communications Lead

Task Groups – Subset of CSC members

1. Baseline and Expected Pathways

Baseline and Expected Pathways Task Group
A. Pacsi (Chevron)
K. Coppola (ExxonMobil)
S. Waltzer (DOE)

2. Detection and Quantification

Detection and Quantification Task Group
D. Allen (UT Austin)
J. Ciferno (DOE)
E. McNamara (DOE)

3. Lifecycle Analysis

Lifecycle Analysis Task Group
F. George (Cheniere)
S. Roman-White (Cheniere)
T. Skone (DOE)

4. Analytics and Tradeoffs

Analytics and Tradeoffs Task Group
A. Dewar (Boston Consulting Group)
M. Gebbia (The Williams Companies)
T. Curry (DOE)

5. Societal Considerations and Impacts

Societal Considerations and Impact Task Group
N. Qamar (Shell)
M. Hastings (CGMF)
N. Dobson (DOE)

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